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ABSTRACT

As universities gain access to satellite delivery systems, faculty are asking questions about how information processing varies between print versus television delivery systems. A study compared 68 undergradaute adults' information processing activity when the same message is presented in print vs. on television. Results reveal little differences in the way readers vs. television viewers process information. No differences across conditions were found for the following variables: attention (measured as amount of invested mental effort and also by a reaction time secondary task); elaboration; memory of central content; enjoyment; and performance on recall memory tasks. Only two information processing differences were found across media conditions. First, readers reported more visualization of content than did television viewers. Second, contrary to theoretical predictors, time spent processing the message was greater for television viewers than for readers. (Contains 24 references.) (Author/RS)

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Television viewing vs. reading:

Testing Information Processing Assumptions

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ABSTRACT

Television Viewing vs. Reading:

Testing Information Processing Assumptions

As universities gain access to satellite-delivery systems, faculty are asking questions about how information processing varies between print vs. televiewing delivery systems. This study compares adults' (n = 68) information processing activity when the same message is presented in print vs. on television.

Results reveal little differences in the way readers vs. television viewers process information. No differences across conditions were found for the following variables: attention (measured as AIME and also by an RT secondary task); elaboration; memory of central content; enjoyment; and performance on recall memory tasks.

Only two information processing differences were found across media conditions. First, readers reported more visualization of content than did television viewers. Second, contrary to theoretical predictions, time spent processing the message was greater for television viewers than for readers.

Television Viewing vs. Reading:
Testing Information Processing Assumptions

The use of new technologies can raise questions that sound familiar, but have not yet been fully answered in the literature. Recently, for example, a four-state group of faculty and county agents was given the opportunity to hold their annual dairy conference via satellite, rather than the tradition of meeting in a central location. Holding the conference via satellite would mean conference speakers would gather in a studio to give live presentations, and other conference participants would view the presentations on a television at local downlink sites, interacting with on-camera experts via telephone. In short, agents would participate in the satellite-delivered teleconference without ever leaving their state, eliminating one or two days required for most participants to travel at to the traditional meeting place.

But, it was asked, doesn't the literature indicate that people tend to view television as a mindless task, suggesting that information processing and learning would be minimal in the satellite-delivery context? If so, would it be better -- more effective in terms of learning -- to print the material, complete with pictures, and mail it to conference participants to read and study as they have time?

In the end, a decision was made to hold a satellite-delivered conference that year. The research reported in this study is an experiment designed to answer the question conference planners

posed -- to determine if adults process educational messages differently when a message is printed, compared to when that same message is televised. This question is important to answer, given the likelihood that future communicators will raise the same question as satellite networks become increasingly available to universities for their educational missions. In addition, the question could not be answered from existing research, because relevant research and theory is based on samples of children, rather than adults, and because all key information-processing assumptions have not been directly tested. Selected studies will now be reviewed in order to identify hypotheses to be tested in this research.

Television Viewing vs. Reading

Personal experience tends to be consistent with the claim that reading is a more difficult cognitive task than televiewing. As discussed below, available theories agree reading and televiewing are not experienced as equally difficult tasks, because receivers tend to process information differently when they read than when they watch television. The theories differ, however, in the explanations offered to account for this phenomenon, suggesting the differences exist either due to medium characteristics (Singer, 1980) or to receivers' perceptions of task difficulty (Salomon, 1979; Salomon & Leigh, 1984). Both perspectives are reviewed below.

Some theorists (Singer, 1980; Winn, 1977) adopt a McLuhan-like argument that reading is necessarily the more engaging cognitive

task, because characteristics of print media cause receivers to process information in more depth while characteristics of the television medium cause receivers to process information in superficial ways (Singer, 1980).

An example of a McLuhan-type theory is offered by Singer (1980) who notes that in general human beings are active information processors who make use of schemata, memory, imagination, on-going thought processes, and anticipations to decide what information should be screened out and how to organize and use other information. While characteristics of the print media allow readers to take full advantage of this cognitive potential, Singer claims, characteristics of television (e.g., rapid pacing) define a medium of such power that these typical information processing activities are unlikely to occur -- or are impossible to execute.

Because Singers' theory explains reading vs. television viewing differences as a function of medium characteristics, the implication is that readers will always -- and necessarily -- process information more thoughtfully and more thoroughly than will television viewers. A different theoretical explanation is offered in the literature, however.

Research by Salomon (1979) and others (Clark, 1983, Krendl, 1986) suggests that the reason why reading is typically experienced as a more difficult task than television viewing is because people expect reading will be the more difficult task. In other words, these preconceived notions become self-fulfilling prophesies: if

you expect reading to be more difficult, you will put more effort into reading than you will into television viewing; the end result is that reading is experienced as the more difficult task.

Salomon's research supports these claims. He found children expect television viewing to be an easier task than reading and that children, therefore, tend to allocate more mental effort to reading than to watching television (Salomon, 1979). As a result, memory of content is often superior in reading compared to televiewing conditions (Salomon & Leigh, 1984).

Although children are predisposed to think viewing television is an easier task than reading, many have demonstrated this biased preconception can be overcome through experimental instructions. When experiments include both media variables (television vs. print) and also a task difficulty factor (hard vs. easy task instructions), results indicate the amount of attention children allocate is influenced more by manipulated task difficulty than by the media factor (e.g., Salomon, 1979, Salomon & Leigh, 1984; Clark 1983; Krendl, 1986).

In other words, the amount of mental effort allocated to a task is a function of perceived task difficulty. In the absence of other cues, preconceptions about the relative difficulty involved in processing information from print vs. television predisposes the receiver to allocate more mental effort to a printed vs. a televised message. However, if cues are provided about the difficulty of an information processing task, children will allocate more mental effort to the complex vs. the simple task,

regardless of the medium delivering the message. In short, it is the receiver who decides how much mental effort to allocate to reading vs. televiewing tasks in Salomon's view, in contrast to Singer's (1980) idea that attention and information processing are dictated by medium characteristics.

Television Viewing vs. Reading: The Need for Additional Research

The findings in this literature do not go far enough to satisfy questions raised by professional communicators. The findings shed doubt on McLuhan-type theories which claim that different information processing styles necessarily exist, due to unique medium characteristics of print vs. television. In addition, Salomon's findings are consistent with an abundance of evidence supporting the idea that attending to television is primarily an active process under the viewer's control and influenced by viewer goals (e.g., Bryant & Anderson, 1983; Meadowcroft & Reeves, 1989).

The problem, however, is that communicators' questions go beyond this control issue. Educators making delivery system choices are looking for fuller descriptions of how information processing varies from one medium to the next in order to determine which delivery system is best suited to educational goals. In the existing literature, television vs. print research has largely focused on the question of viewer control over attention (mental effort) allocated to information processing tasks -- leaving untested many theoretical assumptions about how information processing varies in print vs. television.

Also, as noted earlier, research in this literature is based on samples of children. As universities continue to gain access to new technologies, it will become increasingly important to study how information processing varies across media delivery systems for adult audiences, since it is not clear that results of earlier research will generalize to adult audiences (Pezdek, Simon, Stoeckert & Keily, 1987).

The research reported here attempts to broaden the scope of the existing literature by using adults as subjects and by directly testing a broader range of theoretical predictions concerning differential information processing activity when reading vs. televiewing. It is possible, after all, that even though previous studies indicate receivers exert a great deal of control over attention allocated to print vs. television, medium characteristics may, nonetheless, exert an important influence on other information processing activity. To identify hypotheses for this study, Singer's (1980) theory will be reviewed in more detail below, since his theory offers the most detailed discussion of how information processing varies when watching television, compared to reading.

Television Viewing vs. Reading: Information Processing Assumptions

According to Singer (1980), television's power arises from four medium characteristics that combine to make televiewing a passive task. First, television offers constant stimulus change that "produces a continuous series of orienting reflexes" that capture and hold attention. According to Singer (1980) this continuous orienting response produces a moderate and positive

affect which is addicting so that "the set trains us merely to watch it," p. 51.

The second medium characteristic which renders television viewers as passive recipients of information is the complex array of audio-visual stimuli that impose a situation of information overload. According to Singer, the amount of information presented on television can tax processing capacity to the extent that viewers may not pick up important information, particularly when program content itself is complex.

The final medium characteristics contributing to television's power are the rapid pace of information presentation and the fact that pacing is not controlled by the viewer. Singer claims that rapid pacing of complex television stimuli means television stimuli are "perceived as a blur," because viewers "cannot . . . make precise discriminations between the sights and sounds presented," (p. 39). Singer also claims that rapid pacing contributes to passive information processing, because information is presented and changes so quickly that there is little time for viewers to do much with incoming information. Without adequate time to think about information, he argues, viewers do not have time to pause and reflect upon incoming information. Pacing is so rapid, Singer claims, there is no time to rehearse, elaborate, or integrate TV content with information stored in memory. As a result, cognitive operations which help move information from short-term to long-term memory can not occur, leading to difficulty later when attempting to retrieve information. According to singer, this superficial

processing of information from television leads to strong recognition but poor recall memory.

In contrast, characteristics of print media are thought to encourage in-depth processing and cognitive operations which take full advantage of human information processing capabilities. First, reading environments allow more focused concentration, because they are "relatively free of other visual or auditory distractions," (Singer, 1980, p. 57). Also, Singer (1980) notes, the process of reading itself necessarily involves the execution of more complicated cognitive operations: reading and translating words, in addition to making use of imagination to "see and hear" action depicted in a text. Print "requires us to draw upon our own memories and fantasies, to take the time to try to follow the drift of the writer, and to conjure up by ourselves exotic settings, sights, and sounds suggested in the text," (Singer, 1980, p. 48).

Because television supplies audio and visual information, Singer argues, this same type of imagining does not occur, since television visuals substitute "an external image that one can passively lean on, rather than forming one's own," (Singer, 1980, p. 43). Thus, Singer (1980) claims, reading "engages the brain . . . in a more complex way than does the more passive (television) viewing," (p. 56).

Visuals are not assumed to have the same passive effect when presented with the printed word, however. Indeed, Singer predicts recall of information is enhanced when pictures accompany print, because reading allows for a "more systematic juxtaposition of word

and images than possible under sensory-bombarding conditions of the television set," (p. 58).

Reading is also assumed to be more active than televiewing, because "print sits still and makes a richness of detail available," (Singer, 1980, p. 59). When reading, the pace of incoming information is controlled by the reader, allowing the opportunity to review material, elaborate content, and integrate incoming information with that already stored in memory. As a result, reading is associated with effective recall of program content.

Finally, Singer claims that reading advantages are particularly apparent when complex material is being processed, because the printed word is "critical for adding a logical direction to thought," (p. 59). Therefore, he argues, reading is a superior medium for enhancing recall, particularly when comprehension requires logical organization and thought.

Hypotheses

Singer's theory offers several predictions about how information processing activity varies between reading and television viewing tasks. Those predictions are summarized in the hypotheses listed below -- hypotheses which will be tested under conditions similar to those imposed by educators in real world settings. Adult subjects will be informed they will be tested on material to encourage them to view media processing as a learning task. These instructions provide a research context similar to that educators are likely to encounter when they present messages

in print or on television, adding ecological validity to the study. Hypotheses are also tested in a context which should favor observation of predicted influences. Readers and television viewers will process the same information which gives an overview of Chaos theory, providing a difficult content situation which Singer (1980) predicts will more readily reveal differences in information processing that arise from unique medium characteristics. Given these strategies, the following hypotheses are expected to be supported, if Singer's McLuhan-type assumptions have merit.

Because readers engage in more in-depth processing than television viewers:

H1: Readers will allocate more mental effort (attention) to processing information than will television viewers.

Because television's rapid pacing of information allows viewers little time to spend processing information,

H2: Television viewers will spend less time processing information, compared to readers who have the opportunity to control information pacing, allowing time to review and reflect upon incoming information.

H3: Elaboration of incoming information will be greater for readers than for television viewers.

According to Singer, the amount of information presented on television can tax processing capacity to the extent that viewers

may not pick up important information, particularly when program content itself is complex.

H4: Central program content will be remembered better by readers than by television viewers.

Because television supplies sounds and images which readers must imagine to fully appreciate the text,

H5: Readers will engage in more imagining than will television viewers.

Because television's constant change is assumed to elicit continuous orienting responses that produce positive affect,

H6: Television viewers will enjoy content more than will readers.

Because information processing activity influences memory storage and retrieval,

H7: TV viewers will perform better on recognition tests than on recall tests.

H8: Performance on recall memory tasks will be better for readers than for television viewers, especially when pictures accompany the printed text.

Methods

Subjects

Sixty-eight undergraduates enrolled in a media theory course participated in this experiment. Data collection occurred late enough in the semester so that subjects had received a solid foundation in theory and theorizing. Given content selected for the experiment, this was considered important in order to insure

subjects had a solid foundation for processing information about chaos theory in a systematic, logical way -- a requirement favoring hypothesis confirmation, according to Singer (1980).

Design

Block randomization was used to assign subjects to one of four experimental conditions, so the number of subjects (n = 17) in each condition is equal. The four experimental treatment groups included one television condition and three print conditions. In the first print condition, the printed word was not accompanied by pictures. In the second print condition, the printed word was accompanied by helpful photographs -- pictures that offered illustrations of central and often abstract content that would otherwise have to be visualized or imagined by the subject in order to follow the main gist of the message. In the third print condition, the printed word was accompanied by unhelpful photographs -- pictures that depicted incidental content, unrelated to the main point in the message. For example, when the text discussed the types of abstract patterns that emerge from chaos data, the picture in the helpful condition shows those patterns, while the pictures in the unhelpful condition show a photograph of the researcher who talked about those patterns.

The different print conditions were included, because Singer (1980) makes claims that the influence of visuals on information processing is different in television vs. print and because much research supports the idea that not all visuals are equal in terms of their impact on information processing activity (e.g.,

Heuvelman, 1989; Graber, 1990; White, 1983). Thus, it was considered important to examine the influence of different types of photographs in print conditions, rather than assuming all print conditions would yield similar results.

Stimulus Preparation

Stimulus preparation began with a 60-minute NOVA special on chaos theory that was taped off the air when the program was broadcast on PBS. The program was edited using professional editing equipment to cut program length to approximately 12.5 minutes. The edited version of the program included five focal segments: the first described how to play the chaos game; the second discussed Newtonian physics; the third talked about chaos and making weather predictions; the fourth used a butterfly analogy to describe how minute events can have potentially great influences on chaotic patterns; and the fifth talked about chaotic patterns in nature. This edited tape version was seen by all subjects assigned to the television condition.

Materials for the print conditions were prepared as follows. The edited version of the chaos program was transcribed and used as the text for all print conditions. The only change was to replace ambiguous words with their referents. For example, if the transcribed text informed read "this is what did all the work" and "this" referred to a computer, the word "this" was replaced in the print text with "the computer."

Pictures included in print materials were color photographs of still frames from the chaos videotape. The layout of all print

conditions was the same, and made use of a two-column format arranged on an 8.5" X 11" page of paper. Columns were justified to appear professional, and photographs were placed in the same position on each page for all print picture conditions. In the no-picture condition, blank spaces appeared where photographs were placed in other print conditions so that the amount of information per page was held constant across all print conditions. Once the print layout was completed, experimental materials were photocopied in full color so that photographs in the print conditions were presented in color, as they were also presented on television.

Procedures

Ss were told they would be tested on chaos theory after viewing the video tape or reading the text. Testing involved a post-viewing questionnaire administered immediately after exposure and again approximately one week later. All procedures and testing were performed for individual Ss, except for the delayed post test which was administered to Ss as a group in the classroom.

Analysis Strategy

Various theories suggest that information processing occurs on at least three levels: (1) a micro level that involves processing stimulus events; (2) a local level that involves making sense of information units; and (3) a more global level that involves making connections between information units (Huston & Wright, 1983; Thorson, Reeves & Schleuder, 1987; Lang, 1992). As a result, it is possible that assumptions based on Singer's (198) theory might occur at one or all of these processing levels. To allow this idea

to be explored, measures for this study are constructed so that hypotheses can be tested on both local and global levels, as described below. Local here refers to a program segment, and global refers to the program overall.

Measures

Attention/AIME. Two distinct methods were used to measure attention. First, attention was measured as AIME (amount of invested mental effort), following procedures developed by Salomon (1979). This involved the use of a survey item on the post test, asking Ss to report how much mental effort they exerted while (reading/watching tv). This question was asked individually for each of the five program segments, and Ss responded on a 10-point scale, with 1 indicating very little AIME and 10 indicating a great deal of AIME.

Six attention measures are available from the AIME data. First, responses to the AIME question for each of the five program segments yield an estimate of local AIME for each segment. Also, average AIME was calculated across all five program segments as an estimate of global AIME allocated to the program overall.

Attention/RT. Since Salomon's (1979, 1984) research, the media literature has increasingly adopted a different method to measure attention which assesses allocation of mental effort as it occurs during information processing, rather than relying on the accuracy of a Ss post hoc recall in answering AIME-like survey questions. In order to allow as extensive testing of attention hypotheses as possible, attention is measured in this study using

both Salomon's AIME procedure and the more recent method that allows on-line assessment of attention allocation.

This newer method requires data collection occur in a research laboratory and is based on attention allocation theory (Kahneman, 1973) that assumes attending to something requires mental effort -- a resource limited by a fixed capacity. At any given moment, the amount of mental effort available is fixed, regardless of the number of tasks performed or the difficulty of those tasks. When performing two simultaneous tasks, therefore, this limited attention resource must be divided between tasks, and performance on one task will suffer or fail when attention resources are shifted to a separate concurrent task.

Based on Kahneman's theory, a secondary task is used in this study to measure attention. Subjects perform two simultaneous tasks, an ongoing primary task (reading or televiewing) and a periodic secondary task. The secondary task used in this study requires Ss to respond as quickly as possible to randomly spaced audio tones. The time it took Ss to push a button after tone presentation -- the Ss reaction time (RT) -- is the measure of secondary task performance. Consistent with Kahneman's (1973) theory, it is assumed here that when RT is fast, less attention is being allocated to the primary (media processing) task at that moment, compared to moments when RT is relatively slow.

RT audio cues were presented by an IBM XT Personal Computer that also recorded RT in milliseconds as the measure of secondary task performance. RT cues were presented at the same time in all

conditions, using the moment reading or television viewing began as the starting point, and the time of presentation was recorded by the computer. This allowed RT values to be matched to program segments, knowing, for example, that the first six RT probes were presented during the first televised program segment. To match RT values to content segments in the print condition, researchers watched as Ss read, unobtrusively recording which RT probes were presented while Ss read text for each of the five content segments.

Subjects were given instruction in the secondary task before the experiment began, as well as a practice session where they performed only the secondary RT task to insure Ss understood this task before the experiment began. As above, the RT data was used to create six scales, five representing the average amount of mental effort allocated to each of the five program segments (local), and one measure of overall RT average, representing attention at a global level to the program as a whole (global level).

Time Spent Processing. The amount of time Ss spent processing information is a measure of how long Ss remained engaged in processing information about chaos theory. No assumptions are made that information processing is continuous or that attention allocated to processing is at a constant level. Instead, the idea is to test Singer's notion that readers will spend more time with material, because they review, rehearse, elaborate, and generally think about incoming information more than television viewers. If so, it is likely that the time elapsed between the beginning of the

information processing task and its completion will be greater for readers than for television viewers.

Therefore, the measure of time spent processing is calculated as the time elapsed between the start of information processing and its completion. For television viewers, this variable equals the length of the chaos video tape (12.5 minutes). For readers, the value varies, depending on how long readers took to complete reading the chaos text (experimenters recorded the time Ss began and completed reading tasks). As with the two previous scales, six scales were created, representing the average time spent processing each of the five chaos segments (local), as well as the average time spent processing the material as a whole (global).

Elaboration. Elaboration was coded as two separate variables: related elaboration and unrelated elaboration. To measure related elaboration, Ss were asked: "What did you think about (if anything) related to content being presented during this segment of the (text/program)?" To measure unrelated elaboration, Ss were asked: "Did you think about anything not related to the content when this segment was being (read/presented)?" Ss were asked to report elaboration activity separately for each of the five program segments; one point was awarded for each elaboration reported. As with the other variables, six scales were created representing related elaborations to each of the five program segments (at a local level), as well as to the program as a whole (at a global level). Similarly, six scales were created representing unrelated elaborations.

Imagining (Visualization). Singer states that imagining involves attempts to see and hear action depicted in the text. Imagining was measured here as the average number of visualizations related to program content. For each content segment, Ss were asked: "Did you visualize (form mental pictures) of anything when the (segment topic) was being presented? If yes, what did you visualize? If you want, feel free to provide illustrations of what you pictured." For each reported visualization, one point was awarded, and a scale was created representing the average number of visualizations over the duration of exposure to the chaos material, as well as five scales indicating local visualization during each of the five program segments.

Enjoyment. Subjects' overall enjoyment of the media experience was measured by asking: "How much did you enjoy (watching the program/reading) about chaos theory?" Responses were recorded on a 10-point scale which ranged from 1, very little enjoyment to 10, a great deal of enjoyment.

Memory/Global Knowledge. Several memory scales were created from memory test items included in the immediate post test.[1] First, an overall (global) knowledge score was created by summing the number of correct responses to 30 questions that tested memory of content presented throughout the chaos material.

Memory/Local Knowledge. Five additional scales were created from the 30 memory test items, representing memory of content at the local level for each of the five program segments. The number of items testing memory for content in each segment follows: 5 for

the game segment; 7 for the weather segment; 7 for the butterfly segment; 5 for the Newtonian physics segment; and 6 for the segment on chaos and nature. One point was awarded for each correct response to create local memory scales for each program segment.

Memory/Recognition and Recall. The 30 memory items were also used to create scales representing performance on different types of memory tasks. To test hypotheses concerning recognition and recall performance, for example, correct answers to 17 recognition items were summed to create a scale representing recognition memory, and the number of correct answers to 13 recall items was summed to create a scale representing recall memory. Because hypotheses call for a comparison between performance on recognition vs. recall tasks, the scales were both converted to a 17-point metric, so that the potential range for each scale is 0 to 17.

Memory/Central and Incidental. Similarly, an index representing memory of central content was created by summing the number of correct responses to 15 questions testing memory of central content. In addition, the number of correct responses to 15 items testing memory of incidental content was summed to create an index representing memory of incidental content. Distinctions between central and incidental items was made by five adult judges.

Memory/Visual Recognition. Finally, two of the 30 questions offered a visual recognition test for those in the television and helpful picture conditions, and a visual recognition scale was created by summing the number of correct responses to these two items.

Memory/Delayed Post Test. Identical memory scales were created from the delayed post-test data (administered about 1 week after exposure). The delayed testing session was added, in case immediate testing sessions would not prove sensitive enough to capture predicted influences of medium characteristics on memory.

Perceived Task Difficulty. Ss perceptions of task difficulty were assessed, using procedures developed by Solomon (1979). For each program segment, Ss were asked: "how difficult do you think this segment was to understand?" Ss responded by circling a number on a 10-point scale that ranged from 1, not very difficult, to 10, very difficult. Responses to segment items were also averaged to create a scale representing overall perceived task difficulty for the program as a whole.

Results

Unless otherwise indicated, all hypotheses were tested using One-Way ANOVA. Results are presented below for each hypotheses, for global-level effects first. Tests of hypotheses at the local level are discussed only if results were found to be statistically significant at the .05 level.

Attention

Hypothesis 1 predicted mental effort allocated to the Chaos material would be greater in the print than in the television condition. A first step in testing this hypothesis was to determine if the two global attention measures (overall RT and overall AIME) are correlated, and results indicate they are not, $r = .07$, $p = .61$.

This finding adds an interesting methodological note to this study, since it suggests that survey AIME items and RT secondary task data do not yield assessments of the same aspects of attention processes. Others have noted finding a similar lack of correlation between the measures (Lang, personal communication, 1994) yet no study has systematically examined the problem to offer an explanation for the lack of correlation between the two measures. Two explanations seem likely. One obvious explanation is that the AIME measure is subject to error, since it relies on a respondent's ability to accurately recall mental effort allocated to an information processing task. Another explanation is similar to that offered by Cantor and Hoffner (1990) who explained discrepancies between skin temperature and heart rate measures of fear by noting that "skin temperature is a slow-reacting measure that reflects changes in general state, rather than immediate reactions to stimuli" while "heart rate is highly responsive to a variety of cognitive and attentional processes, and tends to fluctuate in response to momentary changes in stimuli," (pp. 436-437). A similar notion might explain the lack of correlation between AIME and secondary task measures of attention, with AIME measures reflecting a general state and RT data reflecting variance due to both attention and to cognitive activity, as well as responses to micro-level stimulus change. Other explanations are possible, of course, but exploring them is beyond the scope of this paper. Here, suffice it to say that the two measures are not correlated, so testing of hypothesis one will continue, testing the

hypothesis separately for AIME and then for RT measures of attention allocation.

AIME. ANOVA (AIME by media conditions) revealed no significant main effect of media conditions on AIME. Average AIME in the TV condition M = 6.06; M = 6.48 in the print with no picture condition; M = 5.05 in the helpful picture condition; and M = 6.52 in the not helpful picture condition. At the global level, therefore, hypothesis 1 is not supported, when attention is measured as AIME.

Five separate ANOVAS were then used to test for a main effect of media condition on AIME at a local level (for each program segment). Results indicate a main effect of media condition on AIME for two of the five segments: the butterfly segment, $F(3,64) = 2.77$, $p = .049$ and the chaos in nature segment, $F(3,64) = 4.19$, $p = .009$. In the butterfly segment, mean AIME in the TV condition = 5.65; M = 6.00 in the no picture print condition; M = 4.47 in the helpful picture condition; and M = 6.29 in the not helpful picture condition. In the nature segment, mean AIME in the TV condition = 5.76; M = 6.88 in the no picture print condition; M = 4.47 in the helpful picture condition; and M = 6.24 in the not helpful picture print condition.

Based on these results, hypothesis 1 is rejected at the local level when AIME is used to measure attention, because the hypothesis is not supported for 3 of the 5 segments. It is interesting to note, however, that in the two segments where a significant main effect is found, the pattern of results is

generally consistent with the prediction that AIME will be lower in tv vs. print conditions. In fact, for these two segments, AIME is higher in two of the print conditions (not helpful pictures and no pictures) than it is in the television condition, and AIME is lower than television only for the helpful picture condition.

RT. ANOVA (RT by media conditions) revealed no significant main effect of media conditions on RT at the global level. Mean RT in the TV condition = 475.67; M = 451.62 in the no picture print condition; M = 455.94 in the helpful picture condition; and M = 444.24 in the not helpful picture condition. Hypothesis one, therefore, is rejected at the global level, for both AIME and RT measures of attention.

Time Spent Processing

Hypothesis 2 predicted television viewers would spend less time processing the Chaos material, compared to readers. ANOVA revealed a significant main effect of condition on time spent processing; however, the results are not consistent with the hypothesis. TV viewers spent 745 seconds watching the chaos program; readers in the no picture condition spent an average of 614.29 s; M = 624.41 s in the helpful picture condition; and M = 632.24 s in the not helpful picture condition. The Student Newman-Keuls procedure indicated that television viewers spent more time processing the material, compared to the three print conditions. Since this pattern is the reverse of that predicted, hypothesis 2 is rejected.

Elaboration

Hypothesis 3 predicted elaboration would be greater in the reading than in the televiewing condition. Two ANOVA equations were tested related to this hypothesis. The first tested for a main effect of media condition on related elaborations, and the results indicate no main effect. The average number of related elaborations in the tv condition = .82; M = .85 in the no picture print condition; M = .72 in the helpful picture print condition; and M = .80 in the not helpful picture condition.

The second ANOVA tested for a main effect of media condition on unrelated elaborations. Although results indicate un related elaborations are greater in the tv condition (M = 1.05) and the helpful picture print condition (M = 1.14) than in the other two print conditions (M = .65 in the no picture print condition and M = .85 in the not helpful picture condition), the differences are not statistically significant. Hypothesis 3, therefore, is rejected.

Memory of Central Program Content

Hypothesis 4 predicted memory of central content would be superior in the print, compared to the television viewing condition. This hypothesis is not supported, since ANOVA failed to confirm a significant main effect of media condition on memory of central content -- for the immediate memory test or for the delayed testing session. Mean scores for memory of central content in the immediate testing session are: M = 9.47 for the TV condition; M = 8.94 for the no picture print condition; M = 8.35 for the helpful

picture print condition; and M = 8.88 for the not helpful picture print condition. The pattern of results is similar for the delayed testing session where mean scores for memory of central content are: M = 9.06 for the TV condition; M = 9.18 for the no picture print condition; M = 7.47 for the helpful picture condition; and M = 8.94 for the not helpful picture condition. Based on these results, hypothesis 4 is rejected.

Imagining/Visualization

Hypothesis 5 predicted imagining would occur more often for readers than for television viewers. This hypothesis is supported, since ANOVA revealed a main effect of media condition on frequency of imagining, $F(3,64) = 5.92$, $p = .0013$, and the Student-Newman-Keuls procedure verified the average number of visualizations in the TV condition (M = .38) is less than those reported in the print condition (M = .62 in the no picture print condition; M = .61 in the helpful picture print condition; and M = .76 in the not helpful picture print condition), significant at the .05 level.

Enjoyment

Hypothesis six predicted enjoyment of chaos materials would be greater for television viewers than for readers. This hypothesis is rejected, based on lack of significant correlation between the two variables, $r = .13$, $p = .15$.

Recognition vs. recall for television viewers

Hypothesis seven predicted television viewers would perform better on recognition items than on recall items in the memory assessment task, but ANOVA failed to find support for this

hypothesis. After converting recall and recognition scores so that values on each scale have the potential range of 0 - 17, the immediate post test showed television viewers scored an average of 12.35 on the recognition test, compare to an average score of 9.08 on the recall test. Similar results were found in the delayed post test ($\underline{M}$ = 11.71 on the recognition task; $\underline{M}$ = 8.84 on the recall task).

Recall memory in across media conditions

Hypothesis eight predicted performance on recall memory tasks would be better for readers than for television viewers, especially when pictures accompany the printed text. ANOVA failed to support this main effects hypothesis in either post test. Mean recall scores in the immediate post test are: 6.94 for the TV condition; 6.88 for the not helpful pictures print condition; 6.0 for the no picture print condition; and 6.24 in the helpful picture print condition. Mean recall scores in the delayed post test are: 6.76 in the TV condition; 7.06 in the not helpful picture condition; 6.24 in the no picture condition; and 5.41 in the helpful picture condition.

Additional Analyses

As will be recalled, two of the memory items tested visual recognition of chaos patterns shown in the TV and helpful pictures print condition. ANOVA was used to determine if visual recognition scores varied by media conditions, and results revealed all conditions (whether shown those patterns or not) were equally likely to correctly identify chaos patterns discussed in the

text/television program. Results for the immediate post test show mean visual recognition score for the tv condition = 1.94; M = 1.88 in the no picture print condition; M = 1.82 in the helpful picture print condition; and M = 1.76 in the not helpful picture print conditions. Similar results emerged for the delayed testing session: M = 2.0 for the TV condition, compared to M = 1.82 for each of the three print conditions, indicating no significant differences in visual recognition scores across the four media conditions.

A final ANOVA tested perceived task difficulty across the four media conditions. Based on Salomon's theory, one would expect Ss would report television as the easiest task, compared to reading conditions. It was considered important to test this hypothesis in order to determine whether or not notions about task difficulty in this study are consistent with the preconceived task difficulty findings reported by Salomon (1979). As will be recalled, Ss were instructed they would be tested on material in order to increase ecological validity of the study, and we wanted to check to make sure that these instructions did not eliminate typical preconceived notions of differential task difficulty across media conditions. This is particularly important, given the abundance of unsupported hypotheses in this study. Fortunately, ANOVA (perceived task difficulty by media condition) revealed television viewers perceived the task to be easier (M = 4.67), compared to the print conditions (M = 5.81 in the no picture print condition; M = 5.67 in the helpful picture print condition; and M = 6.26 in the not

helpful picture print condition), $F(3,64) = 2.87$, $p = .04$. It cannot be argued, therefore, that experimental instructions "washed out" otherwise present preconceived notions that processing information from television is easier than processing information from print, leading to the many unsupported hypotheses in this study. This lends support to the conclusion that hypotheses were not supported, because predicted effects simply did not occur.

Conclusions

This study was designed to answer a question raised by professional communicators: if people view television as a mindless task so that information process and learning are greater when a message is read, compared to when the message is watched on television, would it be better -- more effective in terms of learning -- to mail out print materials to be read, rather than delivering the information via satellite where it will be presented on a television screen? Assumptions about television viewing as a mindless task that are reflected by this question are widely held -- and are given further legitimacy in the media literature by theories such as those proposed by Singer (1980) and to some extent by research reported by Salomon (1979) and others.

The results of this study, however, suggest that for adult receivers, information processing activity varies little between television and print conditions. This is true, despite the fact that this experiment was designed to provide conditions Singer (1980) claims will favor emergence of media-related differences in information processing activity across media conditions. The

message topic itself is a difficult one, providing a discussion of chaos theory from the field of physics; processing the message requires logical thought; hypotheses were tested at both local and global levels; and different methods were used to measure attention to test hypothesis 1.

Nonetheless, few hypotheses predicting different information processing activity in print vs. television conditions were supported. This is true, despite the fact that reported task difficulty was greater for Ss in the print conditions, compared to reports made by Ss in the television condition. Contrary to predictions, readers did not allocate more mental effort to processing information, compared to television viewers; readers did not elaborate information more than television viewers; readers did not remember central program content better than television viewers; television viewers did not enjoy content more than readers; television viewers did not perform better on recognition tasks than on recall tasks; and recall task performance was not superior in print vs. television conditions. These findings shed doubt on Singer's (1980) claim that processing print necessarily involves the execution of more complicated cognitive operations than is true of televiewing. Instead, results support other media theories that suggest processing information from television requires the use of similar mental operations, such as inference-making, translating medium-specific codes, integrating visual and nonvisual information (when pictures accompany print), and using cognitive skills and metacognitive strategies to help organize and

interpret incoming information (e.g., Collins, 1983; Grimes & Meadowcroft, 1995; Huston & Wright, 1983; Meadowcroft & Reeves, 1989; VanEvra, 1990). In short, results support the idea that both reading and televiewing require the execution of sophisticated mental operations.

Information processing was found to differ in print vs. television groups in only two ways. First, as predicted, readers reported making more visualizations than television viewers reported. This may account for the unexpected finding that visual recognition scores did not vary across media conditions -- a finding particularly surprising when one considers that only Ss in the television and the helpful picture print conditions were shown visuals relevant to the visual recognition task. Apparently, Ss in the other print conditions were successful in generating these visual images on their own, thus, they were able to perform well on the visual recognition task.

The only other way information processing varied across media conditions is that readers spent <u>less</u> time processing the information about chaos theory, compared to the time spent viewing the televised message. This finding, of course, is the opposite of that predicted by hypothesis 2, throwing into doubt the implication of Singer's theory that when given the chance, readers will spend more time reading, reviewing, and thinking about incoming information, compared to television viewers who are at the mercy of television's rapid pacing of information.

The general conclusion, then, is that professional communicators need not be overly concerned that presenting educational messages to adults on a television screen, because results of this study indicate the medium does not encourage a mindless information processing style in a typical learning situation. The key word here, however, is "professional," since it is not at all clear that findings of this study would generalize to a learning context if televised information is not carefully designed and skillfully presented. The producers of NOVA, after all, have a great deal of experience designing messages for presentation on the television screen, and the programs they produce are well designed, paced, and make good use of visuals to illustrate program content. The quality of satellite-delivered teleconference material, on the other hand, varies widely, depending on the skill of the program designers, script writers, producers, communicators, and available resources for preparing visuals, inserting animation and preproduced video segments, and training downlink site coordinators who may or may not provide on-site activities to enhance understanding of program content. When program design, script, and production quality are low, it is unlikely educational content will have the intended impact -- whether the message is presented via print or television.

Footnote

[1] A copy of the 30 items used to assess memory of Chaos material is available from the first author.

References

Bryant, J. and Anderson, D.R. (1983). Children's understanding of television: Research on attention and comprehension. New York: Academic Press.

Cantor, J. and Hoffner, C. (1990). Children's fear reactions to a televised film as a function of perceived immediacy of depicted threat. Journal of Broadcasting and Electronic Media, 34(4), 421-442.

Clark, R. (1983). reconsidering research on learning from the media. Review of educational research, 66(7), 445-449.

Collins, W. A. (1993). Interpretation and inference in children's television viewing. In Bryant, J. and Anderson, D.R. (Eds.), Children's understanding of television: Research on attention and comprehension, pp. 125-150. New York: Academic Press.

Graber, D. (1990). Seeing is remembering: How visuals contribute to learning from television news. Journal of Communication, 40(3), 134-155.

Grimes, T. and Meadowcroft, J.M. (1995). Attention to television and some methods for its measurement. In Brant R. Burleson, (Ed.), Communication Yearbook, 18, pp. 133-161. Thousand Oaks, CA: Sage.

Heuvelman, A. (1989). Cognitive effects of different visual formats in educational television-programme. Communication and cognition, 22(1), 134-155.

Huston, A.C., & Wright, J.C. (1983). Children's processing of television: Informative functions of formal features. In J. Bryant & D.R. Anderson (Eds.), Children's understanding of television: Research on attention and comprehension (pp. 35-68). New York: Academic Press.

Kahneman, D. (1973). Attention and effort. Hillsdale, N.J.: Prentice Hall.

Kerr, B. (1973). Processing demands during mental operations. Memory and cognition, 1, 401-412.

Krendl, K. (1986).

Lang, A. (1992). A limited capacity approach to televiewing. Unpublished manuscript.

McLuhan, M. (1964). Understanding media. New York: Signet Books.

Meadowcroft, J.M. and Reeves, B. (1989). Influence of story schema development on children's attention to television. Communication Research, 16(3), pp. 352-374.

Neuman, S. B. (1991). Literacy in the television age: The myth of the TV effect. Norwood, N.J.: Ablex.

Pezdek, K.; Lehrer, A., & Simon, S. (1984). The relationship between reading and cognitive processing of television and radio. Child Development, 55, 2072-2082.

Pezdek, K., Simon, S., Stoeckert, J. & Keily, J. (1987). Individual differences in television comprehension. Memory and Cognition, 15(5), 428-435.

Salomon, G. (1979). Interaction of media, cognition, and learning. San Francisco: Jossey-Bass.

Salomon, G. and Leigh, T. (1984). Predispositions about learning from print and television. Journal of Communication, 34, 119-35.

Singer, J. L. (1980). The power and limitations of television: A cognitive-affective analysis. In Percy H. Tannenbaum (ed.), The entertainment functions of television, pp. 31-65. Hillsdale, N.J.: Erlbaum.

Thorson, E., Reeves, B., & Schleuder, J. (1987). Attention to local and global complexity in television messages. In M.L. McLaughlin (Ed.), Communication yearbook 10 (pp. 366-383). Newbury Park, CA: Sage.

Van Evra, J. (1990). Television and child development. Hillsdale, N.J.: Lawrence Erlbaum.

White, S.E. (May 1983). The effect of form complexity of television on the identification/recognition process. Paper presented at the annual meeting of the International Communication Association, Dallas, TX.

Winn, M. (1977). The plug-in drug. New York: Bantam.